Influence of Urban Heat Island Phenomenon in the Central Tokyo on Nocturnal Local Wind System in Summer: A Case Study Using Atmospheric Pressure Data of High Density Observation Network

Reprinted from *Tenki*,60-7,p505-519,2013.

Influence of Urban Heat Island Phenomenon in the Central Tokyo on Nocturnal Local Wind System in Summer: A Case Study Using Atmospheric Pressure Data of High Density Observation Network

Kazuyuki TAKAHASHI*1 and Hideo TAKAHASHI*2

*1 (*Corresponding author*) *Tokyo Metropolitan Research Institute for Environmental Protection / Department of Geography, Tokyo Metropolitan University (Present affiliation: Bureau of Urban Development, Tokyo Metropolitan Government, 1-1-6 Sotokanda, Chiyoda-ku, Tokyo, 101-0021, Japan).*

*2 *Department of Geography, Tokyo Metropolitan University.*

(Received 23 October 2012; Accepted 24 March 2013)

Abstract

The present study analyzed the influence of the urban heat island (UHI) phenomenon in Tokyo on the nocturnal atmospheric pressure distribution and local wind system by using observed atmospheric pressure data in the central Tokyo and its surroundings. We used the atmospheric pressure data observed at the JMA observatories located in and around the central Tokyo, and that observed by METROS network which had been installed in the Tokyo wards area. The atmospheric pressure data of METROS included specific instrument errors. Moreover, the observational instruments had already been removed. Therefore we corrected the atmospheric pressure data by assuming hydrostatic equilibrium. We focused on the period from July to August 2004 which was a hot summer. The results of the present study can be summarized as follows:

1) The formation process of a remarkable low pressure area due to the development of the UHI in the central Tokyo was shown for the first time by using observed data. Moreover, it was shown that the high temperature and low pressure areas existed together, and that they moved together toward the central Tokyo as time passed.
2) In the middle of the night, it was shown that a local wind front advanced toward the central Tokyo from the inland side. The front arrived at the central Tokyo at about 0300 JST, and it advanced near the coast temporarily. However, it began to retreat at about 0600 JST, and as a result it did not head out to Tokyo Bay.
3) By analyzing the front stagnation using the atmospheric pressure distribution, it was revealed that the high temperature due to the UHI caused a maximum about 0.5 hPa low pressure in the central Tokyo compared with Tokyo Bay. It is found that the stagnation was caused by the southerly wind converging from the southern high pressure area to the central Tokyo, and the southerly general wind flowing on Tokyo. Similarly to the stagnation of the sea breeze front in the afternoon shown in the previous studies, the high temperature due to the UHI affected the front stagnation of the nocturnal local wind shown in the present study.